

REMARKS

The Official Action dated December 14, 2007 has been carefully considered. Accordingly, the present Amendment is believed sufficient to place the present application in condition for allowance. Reconsideration is respectfully requested.

By the present amendment, claim 1 is amended to positively recite the high-molecular weight polyester as the reaction product of (a) the ring-opening (co)polymer and (b) the oxazoline compound, in accordance with the teachings throughout the present specification. Claim 11 is amended, and claims 29-31 are presented, to recite the amount of oxazoline compound employed, in accordance with the teachings of the specification at page 13, lines 9-13 and Example 2, which employs 1 part by weight oxazoline compound per 100 parts by weight of ring-opening (co)polymer. Claims 1 and 11 have been amended to recite that the ratio (Mw_2/Mw_1) is 1.65 to 5.00, as disclosed in Example 2, for example, in the present specification at page 24, Table 1. Claims 1 and 11 have also been amended to recite that the weight average molecular weight (Mw) of the ring-opening (co)polymer after the chain lengthening, whose molecular weight has been increased by the chain-lengthening reaction, is 181,000 to 500,000, in accordance with the teachings of Example 2, for example, in the present specification at page 24, Table 1, and to recite that a molecular weight distribution (Mw/Mn) represented by a ratio of a weight average molecular weight (Mw) of the ring-opening (co)polymer, whose molecular weight has been highly increased by the chain-lengthening reaction, to a number average molecular weight (Mn) thereof is 2.30 to 4.50, as disclosed in Example 2, for example, in the present specification at page 24, Table 1. Finally, claims 1 and 11 have been amended to recite

that the difference ($T_2 - T_1$) is 15°C to 30°C, in accordance with the teachings of the present specification at page 18, lines 14 to 15. Claims 5, 18 and 26 have been amended to correspond with claims 1 and 11, respectively. Claims 7 and 24 have been amended to recite the 1%-weight loss starting temperature T_2 as at least 252°C, as set forth in Examples 2 and 3, for example, at page 24, Table 1, of the present specification. Since these changes are believed to avoid any introduction of new matter, entry of the amendments is believed to be in order and is respectfully requested.

Claims 2-4, 6, 8, 9, 12-17, 19-22, 25 and 27 have been canceled from the application, and claims 1, 5, 7, 10, 11, 18, 23, 24, 26 and 28-31 are pending.

As defined by claim 1, the present invention relates to a high-molecular weight aliphatic polyester, whose molecular weight has been highly increased. The high-molecular weight polyester comprises a chain-lengthening reaction product of (a) a ring-opening (co)polymer of glycolide or a mixture containing at least 70% by weight of glycolide and at most 30% by weight of another cyclic monomer, and (b) an oxazoline compound having at least two oxazoline ring structures in its molecule to the extent that a ratio (Mw_2/Mw_1) of a weight average molecular weight (Mw_2) of the ring-opening (co)polymer after the chain lengthening to a weight average molecular weight (Mw_1) of the ring-opening (co)polymer before the chain lengthening is 1.65 to 5.00.

The ring-opening (co)polymer has a weight average molecular weight of at least 30,000 before the chain lengthening and is subjected to the chain-lengthening reaction to produce the high-molecular weight ring-opening (co)polymer. The weight average molecular weight (Mw)

of the ring-opening (co)polymer after the chain lengthening, whose molecular weight has been increased by the chain-lengthening reaction, is 181,000 to 500,000. A molecular weight distribution (M_w/M_n) represented by a ratio of a weight average molecular weight (M_w) of the ring-opening (co)polymer, whose molecular weight has been highly increased by the chain-lengthening reaction, to a number average molecular weight (M_n) thereof is 2.30 to 4.50. A difference ($T_2 - T_1$) between a 1%-weight loss-starting temperature T_2 on heating of the ring-opening (co)polymer after the chain lengthening and a 1%-weight loss-starting temperature T_1 on heating of the ring-opening (co)polymer before the chain lengthening is 15°C to 30°C.

The thus defined high-molecular weight aliphatic polyester is excellent in mechanical strength and exhibits markedly improved heat resistance, as demonstrated by $T_2 - T_1$ of 15°C to 30°C. Accordingly, the polyester may be used in a wide variety of fields as extruded products, compression-molded products, injection-molded products, blow-molded products and composite materials (see, for example, the present specification at page 25, lines 5-13).

As defined by claim 11, in the process for producing a high-molecular weight aliphatic polyester according to the present invention, the ring-opening (co)polymer and 1 to 10 parts by weight of the oxazoline compound per 100 parts by weight of the ring-opening (co)polymer are subjected to the chain-lengthening reaction under conditions wherein the reaction temperature is not lower than the melting temperature of the ring-opening (co)polymer, but not higher than 300°C, and the reaction time is 10 to 30 minutes. By this process, a high-molecular weight ring-opening (co)polymer having the above properties is obtained. A comparison of Examples 1 and 2 at pages 22-24 shows that the claimed properties are not inherent in all reaction products of a

ring-opening (co)polymer of glycolide and an oxazoline compound, but are provided by the production process of claim 11.

According to the present invention, high-molecular weight polyglycolic acid (polyglycolide), which is difficult to obtain by the ring-opening polymerization of glycolide, can be obtained by the chain-lengthening reaction using the oxazoline compound. The high-molecular weight polyglycolic acid having a weight average molecular weight of 181,000 to 500,000 obtained by the chain-lengthening reaction is excellent in mechanical strength and moreover markedly improved in heat resistance. In order to efficiently increase the molecular weight by the reaction with the oxazoline compound to provide the aliphatic polyester having a sufficiently high molecular weight, the ring-opening (co)polymer has a weight average molecular weight of at least 30,000 before the chain lengthening and is subjected to the chain-lengthening reaction to produce a high-molecular weight ring-opening (co)polymer. The polyglycolic acid obtained by the chain-lengthening reaction is markedly improved in heat resistance as compared with the polyglycolic acid obtained by the ring-opening polymerization as shown by the difference ($T_2 - T_1$) of 15 to 30°C. Further, the polyglycolic acid obtained by the chain-lengthening reaction is markedly improved in processability by the fact that the molecular weight distribution (M_w/M_n) is as broad as 2.30-4.50.

In the Official Action, claims 1, 5, 7, 10 and 22 were rejected under 35 U.S.C. §102(b) as being anticipated by the Shinoda et al U.S. Patent No. 5,247,013. The Examiner asserted that the high molecular weight aliphatic polyester of claim 1 is viewed as a product-by-process claim whereby the method of creating the polyester (i.e., by reaction with an oxazoline) is not pertinent

unless Applicants can show a different product is produced. The Examiner relied on Shinoda et al as disclosing polyesters formed from glycolic acid and having a Mw of 155,400 and a PDI of 3.7, referring to Example 11 of Table 2 wherein $Mw = Mn \times PDI$.

This rejection is traversed and reconsideration is respectfully requested. Specifically, Applicants find no teaching by Shinoda et al relating to a reaction product of polyglycolic acid with an oxazoline compound, particularly having an Mw of 181,000 to 500,000. On the other hand, claim 1 recites a high molecular weight polyester comprising the reaction product of a ring-opening (co)polymer of glycolide and an oxazoline compound having an Mw of 181,000 to 500,000. The recitation of a reaction product of specified reactants and of specified weight average molecular weight are not process limitations. As Shinoda et al do not teach the reaction product of, inter alia, an oxazoline compound, and do not disclose an Mw as claimed, Shinoda et al do not disclose each and every element as set forth in claim 1 and therefore Shinoda et al do not anticipate claim 1, or claims 5, 7 and 10 dependent thereon, under 35 USC §102, *In re Robertson*, 49 USPQ2d 1949, 1950 (Fed. Cir. 1999). Accordingly, the rejection based on Shinoda et al has been overcome. Reconsideration is respectfully requested.

Claims 1, 5, 7, 10 and 22 were rejected under 35 U.S.C. §102(b) as being anticipated by the Matsumoto et al Japanese reference JP 2001/323056. Claims 11, 17, 18 and 23-28 were rejected 35 U.S.C. §103(a) as being unpatentable over Matsumoto et al. Finally, claims 1, 5, 7, 10, 11, 17, 18 and 21-28 were rejected under 35 U.S.C. §103(a) as being unpatentable over the Bonsignore U.S. Patent No. 5,470,944 in view of Matsumoto et al.

These rejections are traversed and reconsideration is respectfully requested. The high-molecular aliphatic polyesters defined by claims 1, 5, 7 and 10 and the processes for producing a high-molecular weight aliphatic polyester defined by claims 11, 18, 23, 24, 26 and 28 are neither anticipated by Matsumoto et al nor rendered obvious over Matsumoto et al or over Bonsignore in view Matsumoto et al.

Importantly, the present independent claims 1 and 11 recite specific properties of the high-molecular weight aliphatic polyester, for example, as having a ratio (Mw_2/Mw_1) of a weight average molecular weight (Mw_2) of the ring-opening (co)polymer after the chain lengthening to a weight average molecular weight (Mw_1) of the ring-opening (co)polymer before the chain lengthening of 1.65 to 5.00, a molecular weight distribution (Mw/Mn) of the ring-opening (co)polymer after the chain-lengthening reaction of 2.30 to 4.50, and a difference ($T_2 - T_1$) between a 1%-weight loss-starting temperature T_2 on heating of the ring-opening (co)polymer after the chain lengthening and a 1%-weight loss-starting temperature T_1 on heating of the ring-opening (co)polymer before the chain lengthening of 15°C to 30°C. A comparison of Examples 1 and 2 of the present specification shows that all of these properties are not inherent in any reaction of a ring-opening (co)polymer of glycolide and an oxazoline compound, or in any chain lengthening reaction, but are provided in a process as claimed, wherein, as in claim 11, the chain-lengthening reaction is conducted in the presence of the oxazoline compound in a proportion within a range of 1 to 10 parts by weight per 100 parts by weight of the ring-opening (co)polymer.

Matsumoto et al do not expressly or inherently describe all the limitations of the present claims. As discussed in detail previously, and demonstrated by their viscosity data, Matsumoto et al teach an end capping reaction, not a chain-lengthening reaction. Further, Matsumoto et al disclose in Example 3 that “After the PGA chips were dried under reduced pressure for 12 hours at 130°C, heated and melted liquid PBO was weighed in such a manner that PGA:PBO is 99.04:0.96 (by weight) and continuously added to the PGA chips” (in the previously submitted English translation of JP 2001/323056, page 18, lines 27-30, the underlined portion was incorrectly stated as “PLLA” but should have read “PGA”). Accordingly, Example 3 of Matsumoto et al and claim 11 of the present application are different in the amount of the oxazoline compound incorporated. Just as identical processes may be presumed to provide identical products, products are generally presumed to be different from each other when their production processes are different. Accordingly, the reaction product of the ring-opening (co)polymer and the oxazoline compound as presently claimed is clearly different from the PGA chips in Example 3 of Matsumoto et al in view of the difference in the amount of oxazoline incorporated therein.

Additionally, and importantly, according to the end terminating method of Matsumoto et al, the aliphatic polyester resin and the end terminating agent are melted and kneaded at a high temperature, but are extruded by means of the twin-screw kneader extruder in a short kneading period of time. Therefore, the carboxyl end groups of the aliphatic polyester resin are terminated with the oxazoline compound, but a chain-lengthening reaction as presently claimed does substantially not occur. On the other hand, according to the present invention, the chain-

lengthening reaction is caused by reacting the polyglycolic acid obtained by the ring-opening (co)polymerization of glycolide with the oxazoline compound at a high temperature of not lower than the melting temperature of the polyglycolic acid, but not higher than 300°C and in a reaction time of 10 to 30 minutes.

The present specification describes that:

“The reaction with such an oxazoline compound is a chain-lengthening reaction, in which significant increase in the molecular weight of the ring-opening (co)polymer is observed, different from a mere chain-terminating reaction” (Page 15, lines 11 to 15)

According to the process of the present invention, high-molecular weight polyglycolic acid exhibiting an increase in molecular weight as shown by the ratio (Mw_2/Mw_1) of a weight average molecular weight (Mw_2) of the ring-opening (co)polymer after the chain lengthening to the weight average molecular weight (Mw_1) of the ring-opening (co)polymer before the chain lengthening of at least 1.65, can be obtained. Matsumoto et al provide no teaching or suggestion in this regard.

It is the burden of the Examiner to show that a prior art reference discloses all of the limitations necessary to inherently result in a product as claimed. MPEP §2112. The fact that a certain result or characteristic *may* occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic, *In re Rijckaert*, 9 F.3d 1531, 1534, 28 U.S.P.Q. 2d 1955, 1957 (Fed. Cir. 1993). In view of the deficiencies in the general teachings of Matsumoto et al and the deficiencies in the exemplary teachings of Matsumoto et al, it is clear that Matsumoto et al do not provide sufficiently specific teachings for the Examiner to meet this burden.

On the other hand, Bonsignore merely mentions polyglycolic acid is conventionally prepared by condensation polymerization or ring-opening polymerization and is environmentally compatible because it degrades to glycolic acid. No other mention of polyglycolic acid is made and particularly no teaching or suggestion for production of high molecular weight polyglycolic acid is disclosed by Bonsignore. Moreover, Bonsignore provides no basis or apparent reasoning for one of ordinary skill in the art to apply any of Bonsignore's teachings with respect to lactic acid to glycolic acid.

Importantly, Matsumoto et al and Bonsignore do not disclose a high-molecular weight polyester composed of a ring-opening (co)polymer of glycolide obtained by chain lengthening by an oxazoline compound, particularly having the various properties recited in claim 1 and markedly improved in mechanical strength, heat resistance and processability. Further, Matsumoto et al and Bonsignore do not disclose a process for subjecting a ring-opening (co)polymer of glycolide to a chain-lengthening reaction with an oxazoline compound under the reaction conditions recited in present claim 11, and do not teach or suggest that a high-molecular weight polyester having the above-described various properties may be obtained by such a process. It is therefore submitted that the high-molecular weight aliphatic polyester and production process thereof defined by the present claims are neither anticipated by nor rendered obvious over Matsumoto et al and are not rendered obvious over the combination of Bonsignore and Matsumoto et al. Accordingly, these rejections have been overcome, and reconsideration is respectfully requested.

It is believed that the above demonstrates the patentability of present claims 1, 5, 7, 10, 11, 18, 23, 24, 26 and 28, and places the present application in condition for allowance. Reconsideration and an early allowance are requested.

Please charge any fees required in connection with the present communication, or credit any overpayment, to Deposit Account No. 503915.

Respectfully submitted,

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